

## 1500 – 4000 MHz High Linearity LNA

### Device Features

- Operated at 3.0V and 5.0V
- 35.5 dBm Output IP3 at 0dBm/tone at 3500MHz
- 16.4 dB Gain at 3500 MHz
- 20.1 dBm P1dB at 3500MHz
- 0.83 dB NF at 3500MHz
- Fast shut down to support TDD systems
- Green/RoHS2 Compliant DFN 8L 2x2 Package

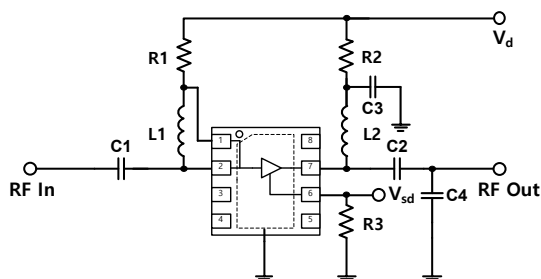
### Product Description

BeRex's BLB03 is a high linearity LNA, based on GaAs material with E-pHEMT process and packaged in a RoHS2-compliant DFN 8L 2x2 mm<sup>2</sup> Surface mount package. It is designed for use where low noise and high linearity are required and features low noise and high OIP3 at Frequency range of 1.5~4.0GHz. It can be used in fast shutdown switching speed for TD-LTE application. All devices are 100% RF/DC tested and classified as HBM ESD Class 1C.

### Applications

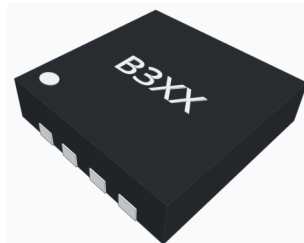
- Base station Infrastructure
- Commercial/Industrial/Military wireless system
- TDD or FDD LTE system/5G NR

### Applications Circuit



| BOM      | 5V Value | 3V Value | 5V Value | 3V Value |
|----------|----------|----------|----------|----------|
| Freq     | 1.5~3G   | 1.5~3G   | 3~4G     | 3~4G     |
| C1,C2,C3 | 20pF     | 20pF     | 20pF     | 20pF     |
| C4       | N/A      | N/A      | 0.3pF    | 0.3pF    |
| R1       | 9.1Kohm  | 6.8Kohm  | 9.1Kohm  | 6.8Kohm  |
| R2       | 3 ohm    | 3 ohm    | 3 ohm    | 3 ohm    |
| R3       | 20kohm   | 20kohm   | 20kohm   | 20kohm   |
| L1       | 15nH     | 15nH     | 15nH     | 15nH     |
| L2       | 8.2nH    | 8.2nH    | 8.2nH    | 8.2nH    |

### Part Marking (XX:Wafer number)



### Electrical Specifications

Device performance \_ measured on a BeRex evaluation board at 25°C, Vd=5V, 50 Ω system.

| Parameter                   | Conditions                 | Min  | Typ   | Max  | Unit |
|-----------------------------|----------------------------|------|-------|------|------|
| Operational Frequency Range |                            | 1500 |       | 4000 | MHz  |
| Test Frequency              |                            |      | 3500  |      | MHz  |
| Gain                        |                            | 14.9 | 16.4  |      | dB   |
| Input Return Loss           |                            |      | -12.9 |      | dB   |
| Output Return Loss          |                            |      | -10.5 |      | dB   |
| Output IP3                  | 0 dBm / tone ,<br>Δf=1 MHz | 32.5 | 35.5  |      | dBm  |
| Output P1dB                 |                            | 19.1 | 20.1  |      | dBm  |
| Noise Figure                |                            |      | 0.83  | 1.03 | dB   |

\* Noise Figure data has input trace loss de-embedded.

Device performance \_ measured on a BeRex evaluation board at 25°C, Vd=3V, 50 Ω system.

| Parameter                   | Conditions                 | Min  | Typ   | Max  | Unit |
|-----------------------------|----------------------------|------|-------|------|------|
| Operational Frequency Range |                            | 1500 |       | 4000 | MHz  |
| Test Frequency              |                            |      | 3500  |      | MHz  |
| Gain                        |                            | 14.2 | 15.7  |      | dB   |
| Input Return Loss           |                            |      | -10.6 |      | dB   |
| Output Return Loss          |                            |      | -11.2 |      | dB   |
| Output IP3                  | 0 dBm / tone ,<br>Δf=1 MHz | 27.8 | 30.8  |      | dBm  |
| Output P1dB                 |                            | 14.8 | 15.8  |      | dBm  |
| Noise Figure                |                            |      | 0.85  | 1.05 | dB   |

\* Noise Figure data has input trace loss de-embedded.

### Recommended Operating Conditions<sup>1</sup>

| Parameter                                | Min  | Typ    | Max  | Unit  |
|------------------------------------------|------|--------|------|-------|
| Bandwidth                                | 1500 |        | 4000 | MHz   |
| I <sub>d</sub> @ (V <sub>d</sub> = 5.0V) | 46   | 57     | 68   | mA    |
| I <sub>d</sub> @ (V <sub>d</sub> = 3.0V) | 27   | 34     | 41   | mA    |
| V <sub>d</sub>                           | 3    | 5      | 5.25 | V     |
| dG/dT                                    |      | -0.008 |      | dB/°C |
| R <sub>TH</sub>                          |      | 34.1   |      | °C/W  |
| Operating Case Temperature               | -40  |        | +105 | °C    |

Electrical specifications are measured at specified test conditions.

Specifications are not guaranteed over all recommended operating conditions.

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## Recommended Operating Conditions<sup>2</sup>

| Paramter                             | Condition                                 | Min. | Typical | Max.            | Unit |
|--------------------------------------|-------------------------------------------|------|---------|-----------------|------|
| Shutdown Control                     | On state                                  | 0    |         | 0.9             | V    |
|                                      | Off state(shutdown)                       | 1.17 |         | V <sub>DD</sub> | V    |
| Current, IDD                         | On state 5V                               | 46   | 57      | 68              | mA   |
|                                      | On state 3V                               | 27   | 34      | 41              | mA   |
|                                      | Off state(shutdown)                       | 5    | 7       | 9               | mA   |
| Shutdown pin current,I <sub>sd</sub> | 1.17V ≤ V <sub>sd</sub> < V <sub>DD</sub> |      | 150     |                 | uA   |
| Switching Time                       | Rise time(10% to 90%)                     |      | 140     |                 | ns   |
|                                      | Fall time(90% to 10%)                     |      | 40      |                 | ns   |

## Absolute Maximum Ratings

| Parameter            | Rating      | Unit |
|----------------------|-------------|------|
| Storage Temperature  | -55 to +155 | °C   |
| Junction Temperature | +160        | °C   |
| Supply Voltage       | +6          | V    |
| Supply Current       | 120         | mA   |
| Input RF Power       | 21          | dBm  |

Operation of this device above any of these parameters may result in permanent damage.

## Typical Performance (V<sub>d</sub>=5.0V, I<sub>d</sub>=57mA, T=25°C)

| Parameter                 | Frequency   |             |             |             | Unit       |
|---------------------------|-------------|-------------|-------------|-------------|------------|
| <b>V<sub>d</sub> = 5V</b> | <b>1850</b> | <b>2140</b> | <b>2650</b> | <b>3500</b> | <b>MHz</b> |
| Gain                      | 20.3        | 19.5        | 18          | 16.4        | dB         |
| S11                       | -14.4       | -15.1       | -15.1       | -12.9       | dB         |
| S22                       | -6.8        | -7.3        | -7.8        | -10.5       | dB         |
| OIP3                      | 33.9        | 34.3        | 35.8        | 35.5        | dBm        |
| P1dB                      | 20.9        | 21.2        | 21          | 20.1        | dBm        |
| Noise Figure              | 0.64        | 0.68        | 0.73        | 0.83        | dB         |

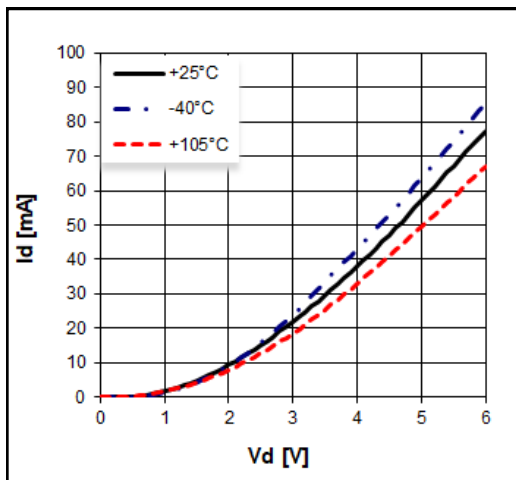
## Typical Performance (V<sub>d</sub>=3.0V, I<sub>d</sub>=34mA, T=25°C)

| Parameter                 | Frequency   |             |             |             | Unit       |
|---------------------------|-------------|-------------|-------------|-------------|------------|
| <b>V<sub>d</sub> = 3V</b> | <b>1850</b> | <b>2140</b> | <b>2650</b> | <b>3500</b> | <b>MHz</b> |
| Gain                      | 19.5        | 18.6        | 17          | 15.7        | dB         |
| S11                       | -11.9       | -12.7       | -12.7       | -10.6       | dB         |
| S22                       | -7.0        | -7.4        | -7.8        | -11.2       | dB         |
| OIP3                      | 29.6        | 29.6        | 30.3        | 30.8        | dBm        |
| P1dB                      | 16.5        | 16.8        | 16.6        | 15.8        | dBm        |
| Noise Figure              | 0.64        | 0.68        | 0.73        | 0.85        | dB         |

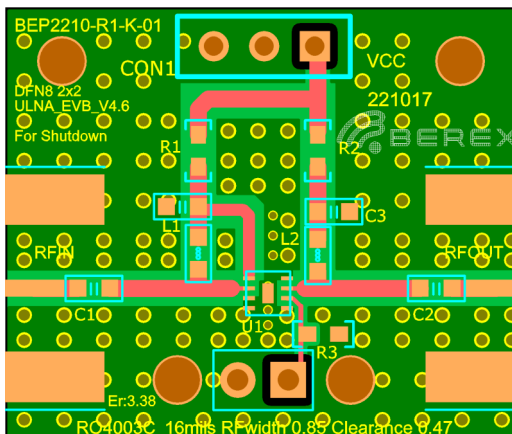


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## V-I Characteristics

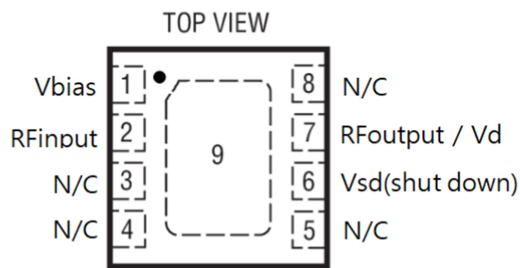


## Evaluation Board



\*Dielectric constant \_ 4.2 \*RF pattern width 24mil \*16mil thick RO4003 PCB

## Pin Configuration and Description



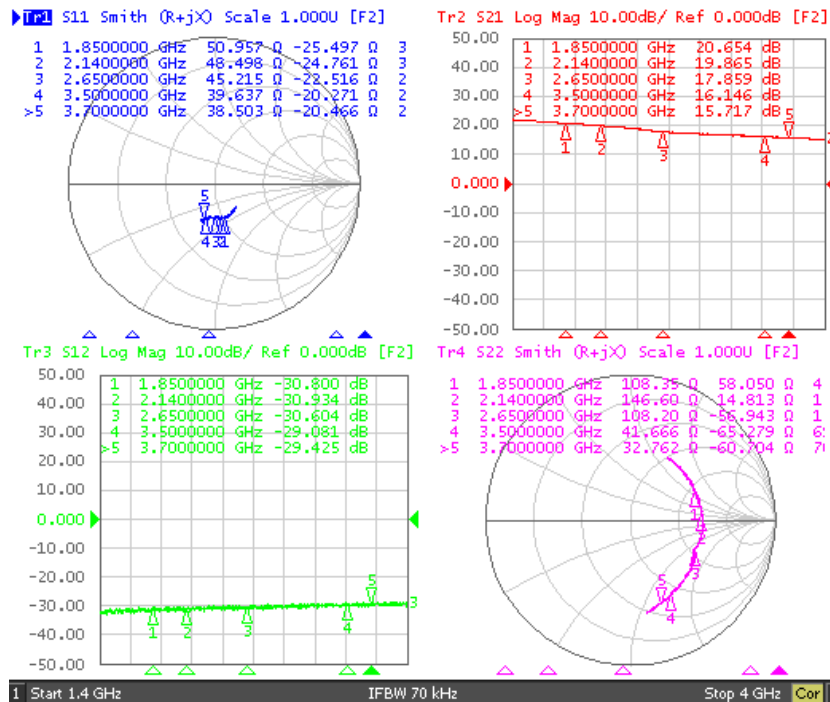
DC PACKAGE  
8-LEAD (2mm × 2mm) PLASTIC DFN

| Pin No. | Name            | Description                                                                                                                         |
|---------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Vbias           | Vbias sets Idq through external resistor for $V_d=5V$ or $V_d=3.3V$ .                                                               |
| 2       | RFinut          | RFinut pin. A DC Block with High Q performance is required.                                                                         |
| 6       | Vsd(shut down)  | Power on/off control pin. $1.17V \leq Vsd$ disables device.<br>Vsd are not loaded, the LNA will operate in its standard "ON" state. |
| 7       | RFoutput / Vd   | RFoutput / $V_d$ pin. Supply $V_d$ through choke/Inductor for the device.                                                           |
| 3,4,5,8 | NC              | No internal connection to die. May be connected to ground.                                                                          |
| 9       | Backside Paddle | Exposed Pad is RF/DC ground, must be soldered to PCB.                                                                               |

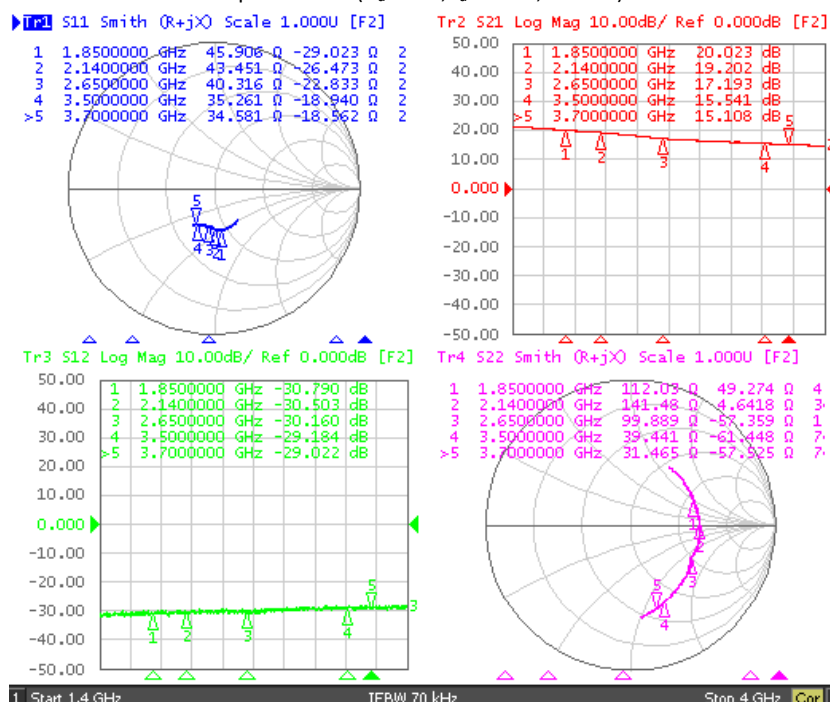
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## Typical Device Data

S-parameters ( $V_d=5.0V$ ,  $I_d=57mA$ ,  $T=25^\circ C$ )



S-parameters ( $V_d=3.0V$ ,  $I_d=34mA$ ,  $T=25^\circ C$ )



# 1500 – 4000 MHz High Linearity LNA

## S-Parameter

(Vd=5.0V, Id = 57mA, T = 25 °C, calibrated to device leads)

| Freq<br>[MHz] | S11<br>Mag | S11<br>Ang | S21<br>Mag | S21<br>Ang | S12<br>Mag | S12<br>Ang | S22<br>Mag | S22<br>Ang |
|---------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 1400          | 0.22       | -48.10     | 12.57      | 138.29     | 0.025      | 50.66      | 0.50       | 59.09      |
| 1600          | 0.24       | -63.52     | 11.77      | 122.96     | 0.026      | 40.26      | 0.50       | 43.40      |
| 1800          | 0.25       | -71.32     | 10.95      | 110.41     | 0.027      | 35.05      | 0.49       | 28.03      |
| 2000          | 0.24       | -76.46     | 10.33      | 98.67      | 0.029      | 35.60      | 0.50       | 14.54      |
| 2200          | 0.24       | -80.73     | 9.69       | 88.18      | 0.029      | 29.61      | 0.50       | 1.12       |
| 2400          | 0.23       | -85.23     | 8.81       | 77.72      | 0.028      | 27.96      | 0.50       | -11.30     |
| 2600          | 0.24       | -87.56     | 7.98       | 70.34      | 0.029      | 22.55      | 0.49       | -22.57     |
| 2800          | 0.24       | -92.60     | 7.49       | 63.96      | 0.030      | 24.65      | 0.51       | -29.18     |
| 3000          | 0.24       | -96.30     | 7.06       | 58.41      | 0.031      | 23.03      | 0.54       | -39.12     |
| 3200          | 0.24       | -100.78    | 6.78       | 50.86      | 0.032      | 21.35      | 0.55       | -48.95     |
| 3400          | 0.25       | -103.61    | 6.55       | 44.42      | 0.032      | 17.00      | 0.58       | -57.57     |
| 3600          | 0.25       | -105.48    | 6.23       | 37.65      | 0.032      | 13.75      | 0.60       | -65.81     |
| 3800          | 0.27       | -108.04    | 5.99       | 31.44      | 0.034      | 13.23      | 0.63       | -73.33     |
| 4000          | 0.28       | -108.31    | 5.81       | 25.18      | 0.033      | 6.89       | 0.65       | -80.04     |

(Vd=3.0V, Id = 34mA, T = 25 °C, calibrated to device leads)

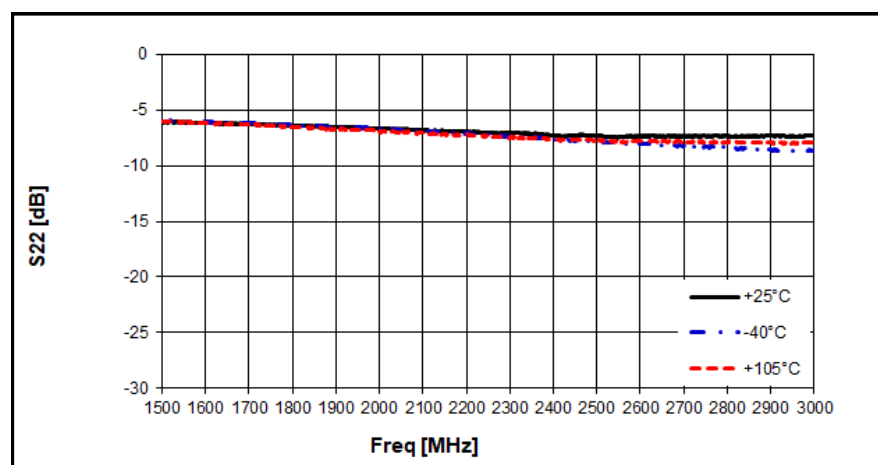
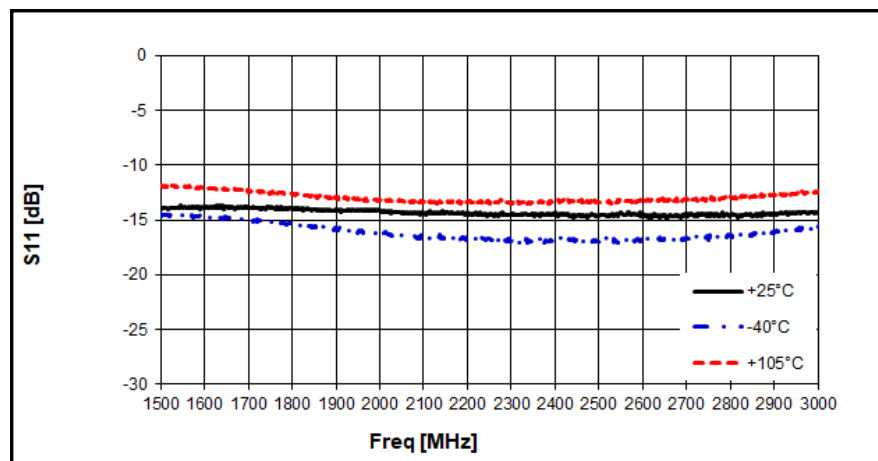
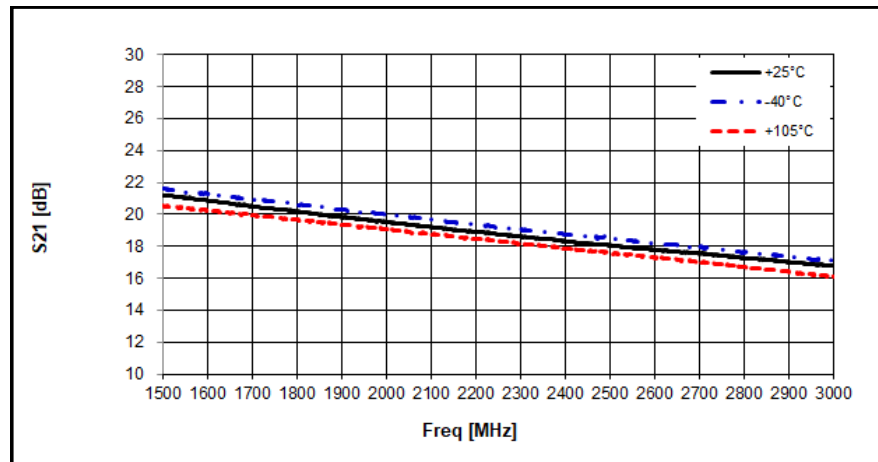
| Freq<br>[MHz] | S11<br>Mag | S11<br>Ang | S21<br>Mag | S21<br>Ang | S12<br>Mag | S12<br>Ang | S22<br>Mag | S22<br>Ang |
|---------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 1400          | 0.27       | -54.12     | 11.68      | 138.84     | 0.027      | 48.70      | 0.49       | 56.43      |
| 1600          | 0.29       | -69.63     | 10.95      | 123.29     | 0.028      | 42.06      | 0.48       | 40.52      |
| 1800          | 0.29       | -78.87     | 10.14      | 110.55     | 0.027      | 42.89      | 0.47       | 24.77      |
| 2000          | 0.28       | -85.20     | 9.60       | 98.75      | 0.030      | 38.74      | 0.47       | 11.24      |
| 2200          | 0.28       | -89.50     | 9.01       | 88.19      | 0.032      | 31.08      | 0.49       | -1.69      |
| 2400          | 0.27       | -93.83     | 8.17       | 77.62      | 0.031      | 30.36      | 0.49       | -14.12     |
| 2600          | 0.27       | -97.66     | 7.41       | 69.90      | 0.032      | 26.40      | 0.48       | -25.52     |
| 2800          | 0.27       | -102.26    | 6.97       | 63.63      | 0.032      | 24.81      | 0.50       | -32.82     |
| 3000          | 0.26       | -106.54    | 6.59       | 57.74      | 0.033      | 22.43      | 0.52       | -42.44     |
| 3200          | 0.26       | -111.13    | 6.32       | 49.91      | 0.035      | 17.74      | 0.54       | -52.02     |
| 3400          | 0.27       | -114.33    | 6.09       | 43.48      | 0.036      | 17.81      | 0.57       | -60.85     |
| 3600          | 0.27       | -116.53    | 5.78       | 36.40      | 0.036      | 13.11      | 0.59       | -68.74     |
| 3800          | 0.28       | -118.25    | 5.59       | 30.09      | 0.037      | 13.41      | 0.62       | -76.76     |
| 4000          | 0.29       | -119.02    | 5.41       | 23.70      | 0.040      | 8.86       | 0.65       | -82.83     |



# 1500 – 4000 MHz High Linearity LNA

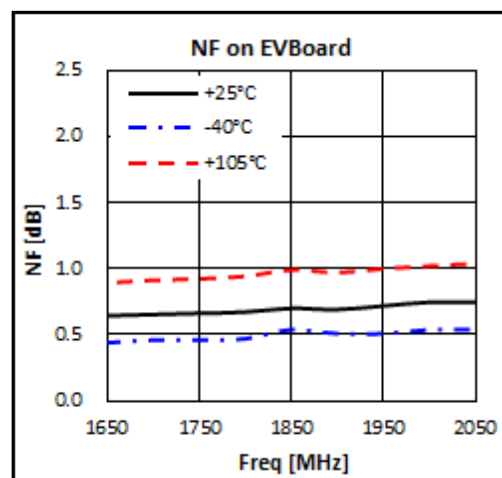
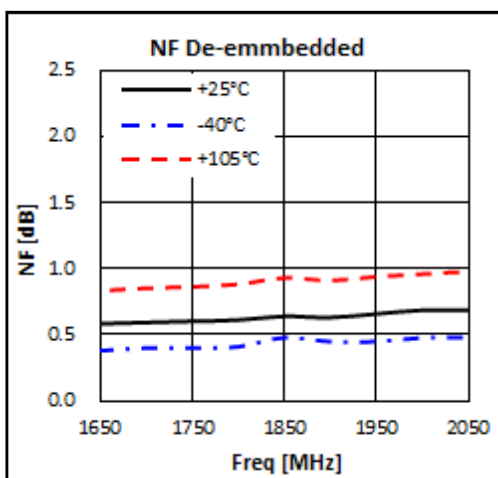
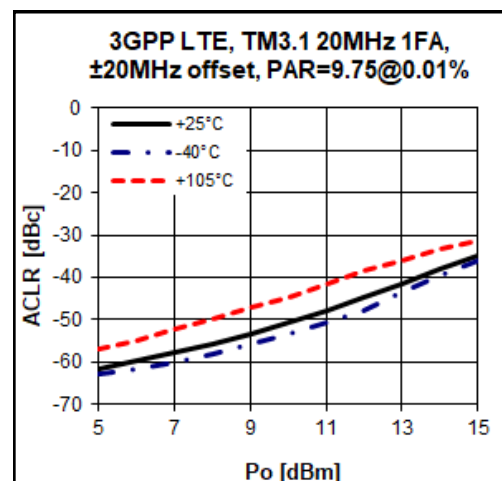
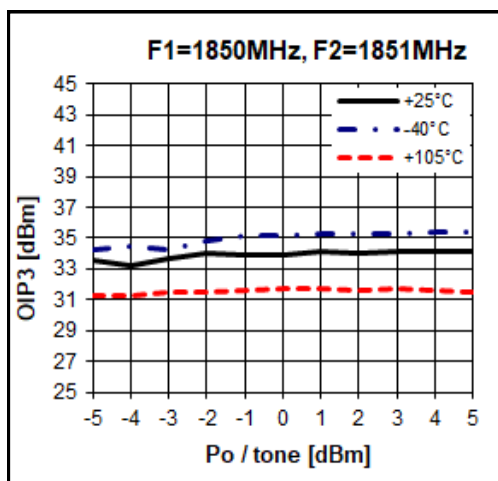
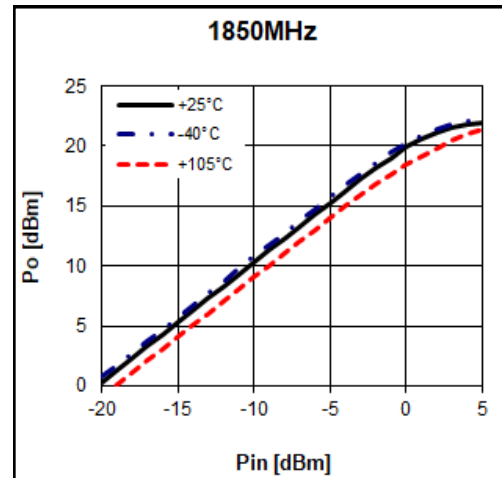
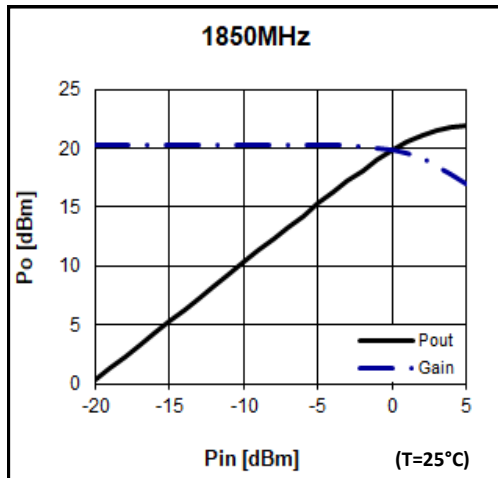
## Typical Performance

$V_d = 5V$ ,  $I_d = 57mA$



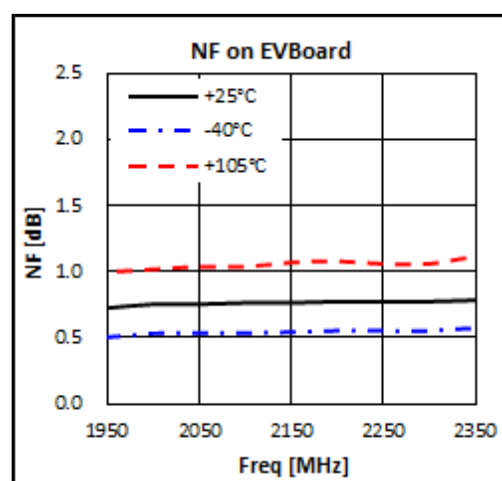
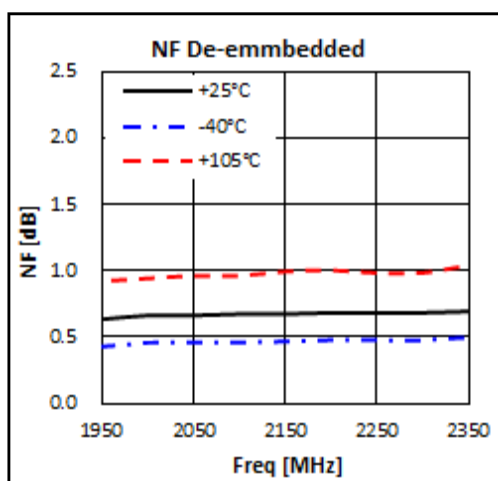
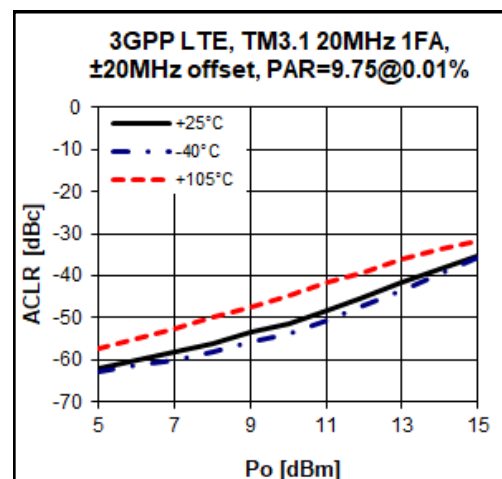
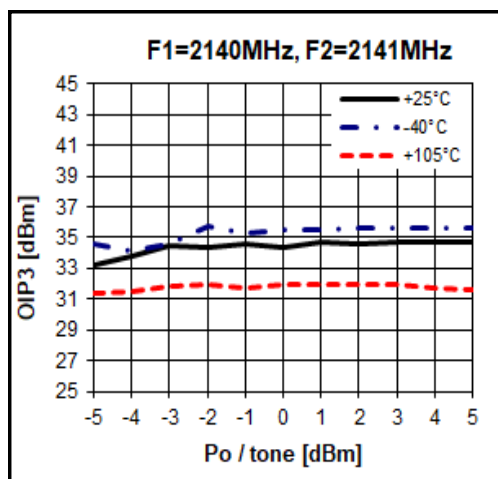
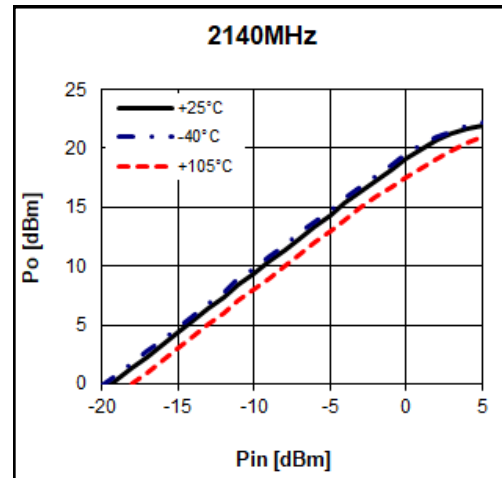
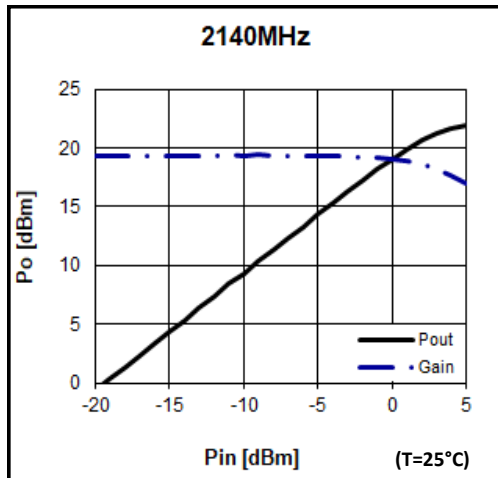
# 1500 – 4000 MHz High Linearity LNA

$V_d = 5V, I_d = 52mA$



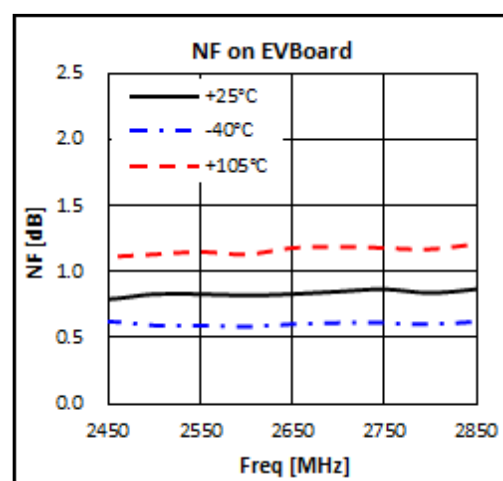
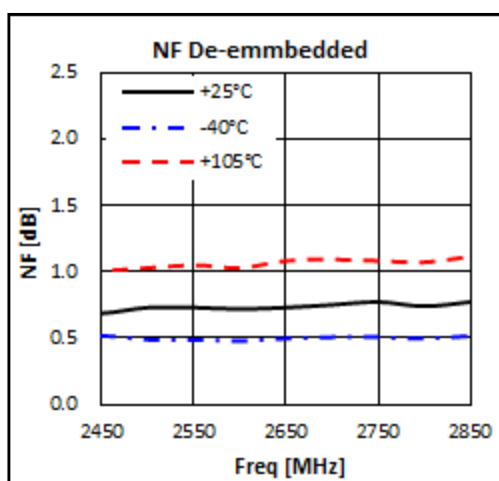
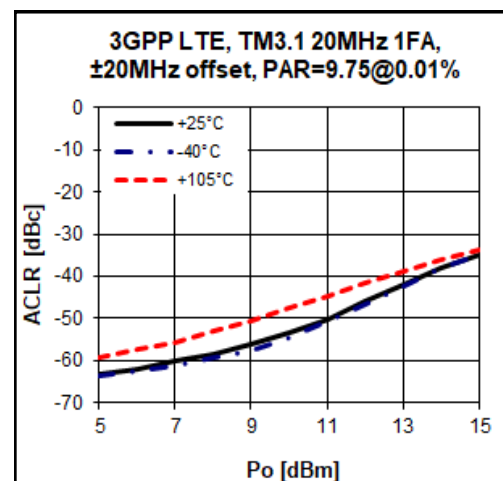
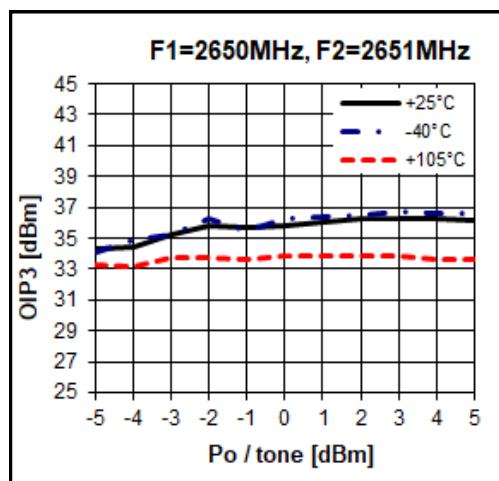
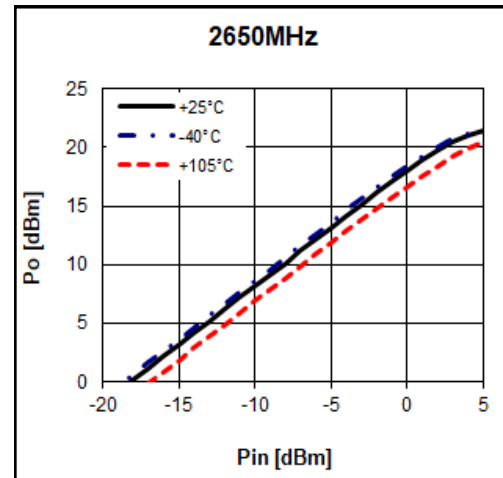
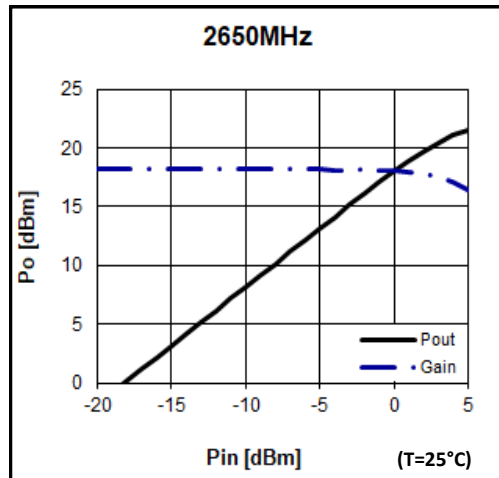
# 1500 – 4000 MHz High Linearity LNA

$V_d = 5V, I_d = 52mA$



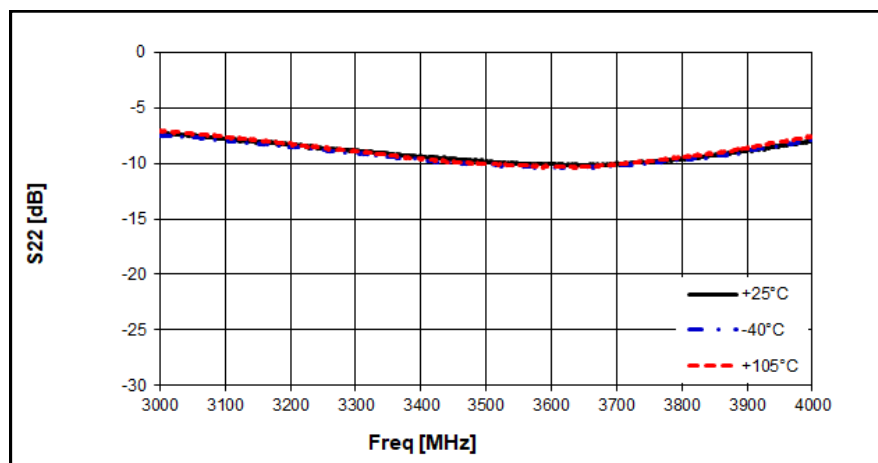
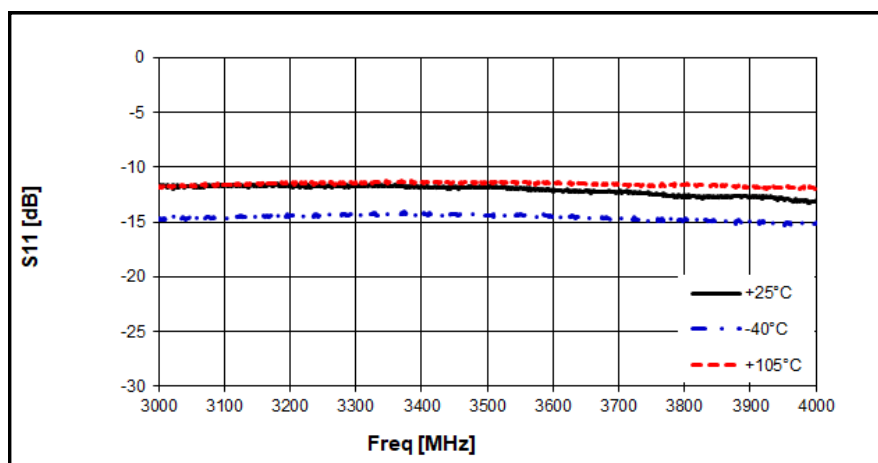
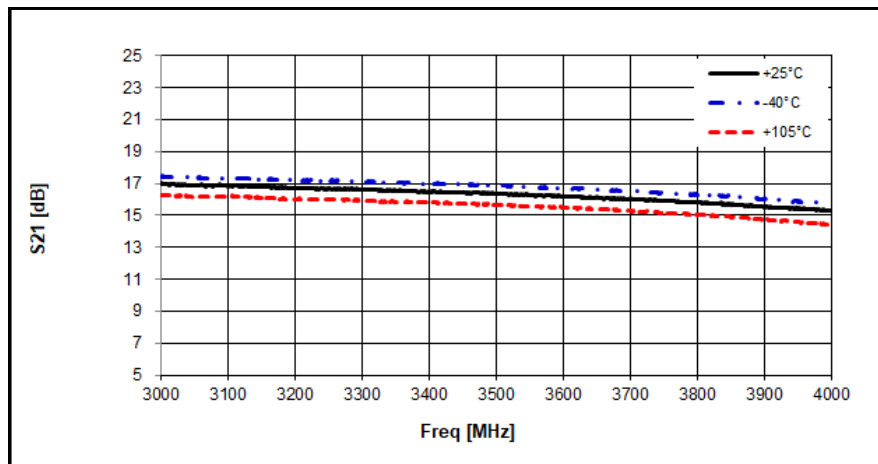
# 1500 – 4000 MHz High Linearity LNA

$V_d = 5V, I_d = 52mA$



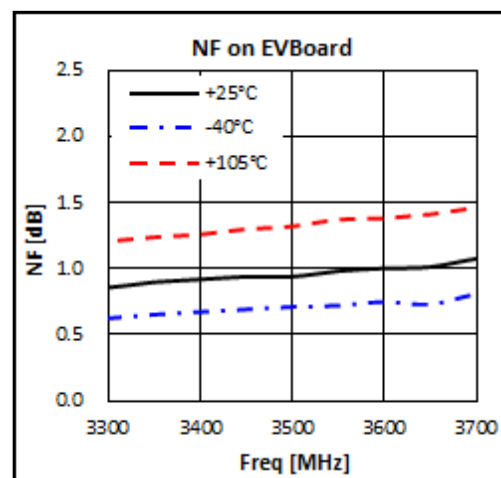
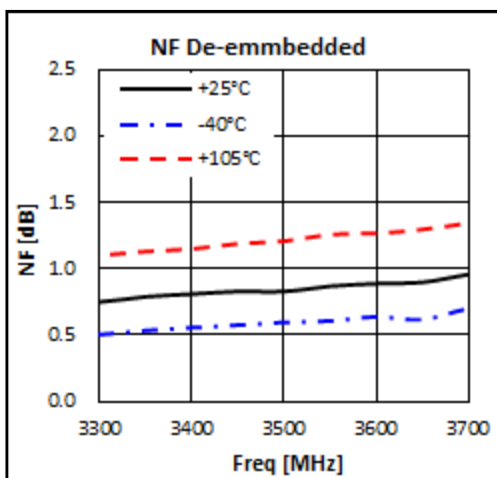
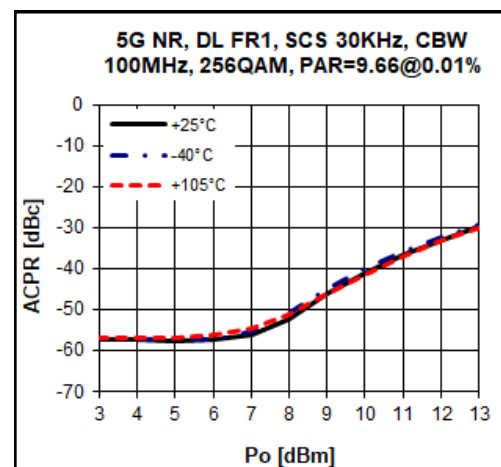
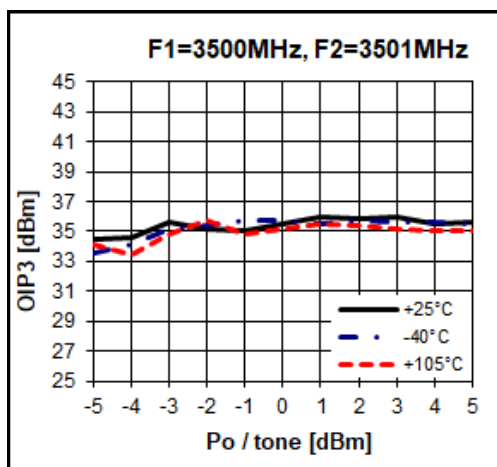
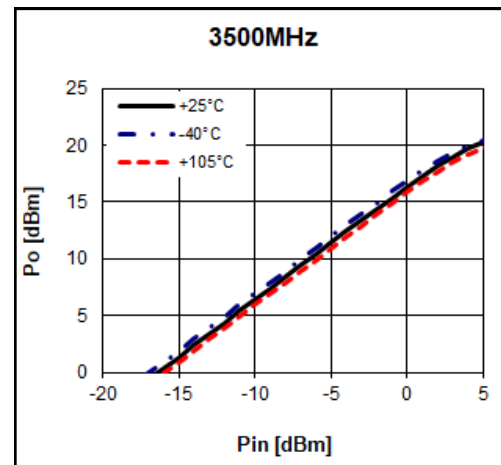
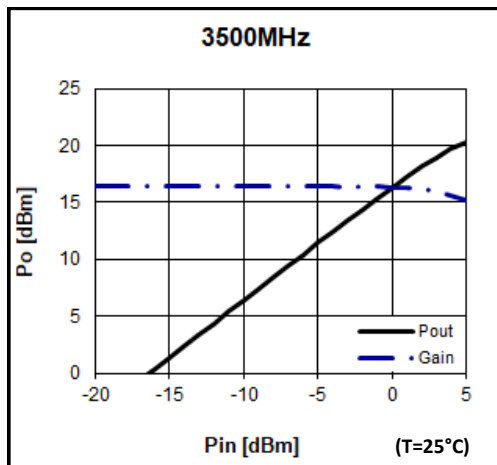
# 1500 – 4000 MHz High Linearity LNA

$V_d = 5V, I_d = 57mA$



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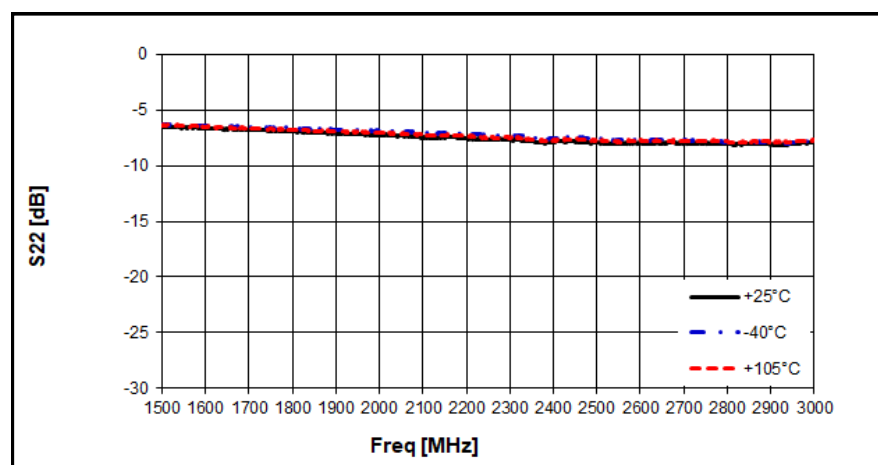
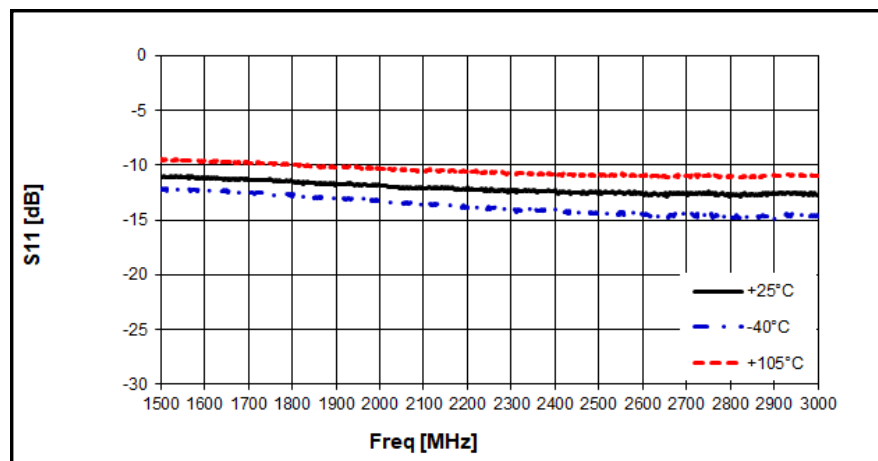
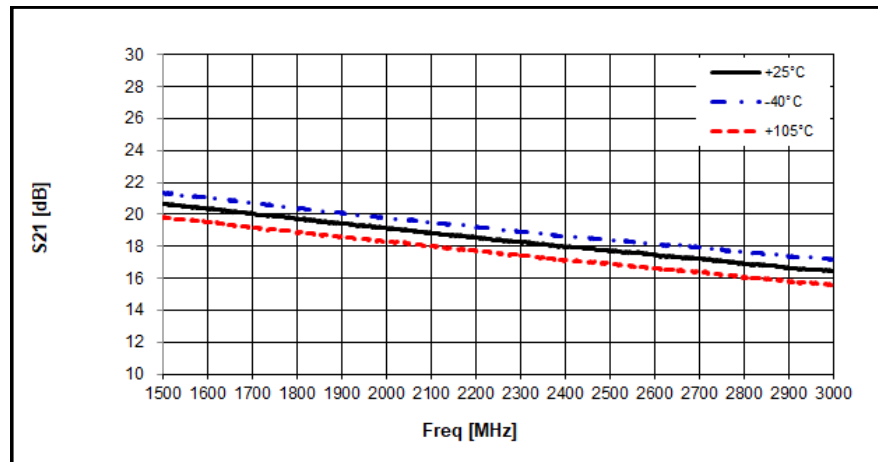
$V_d = 5V, I_d = 52mA$



# 1500 – 4000 MHz High Linearity LNA

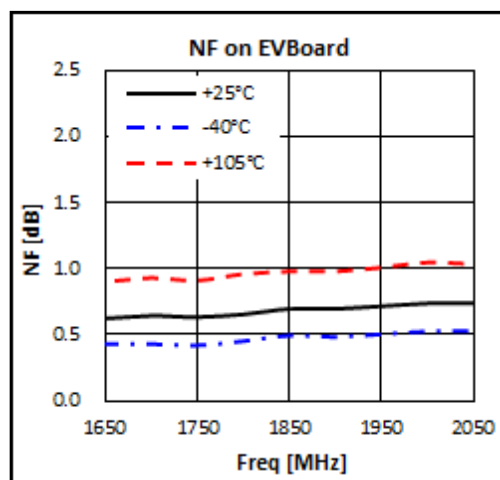
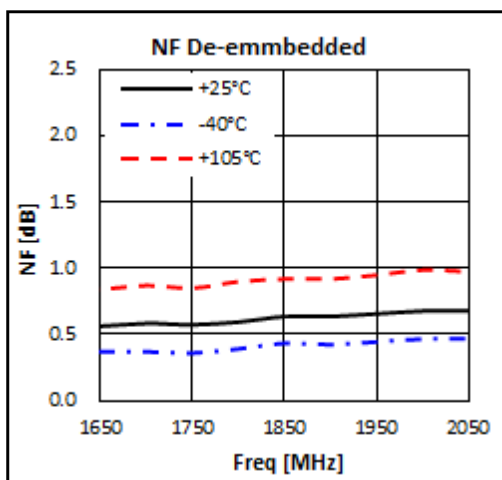
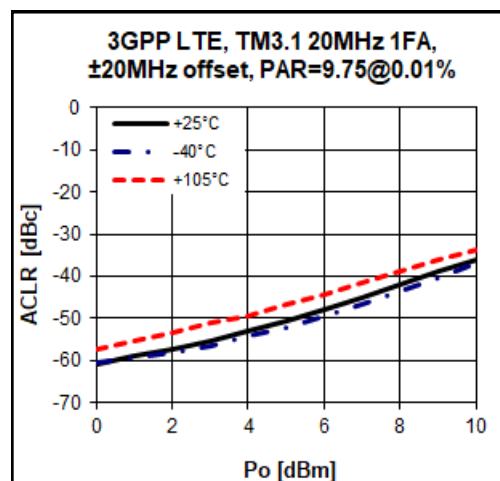
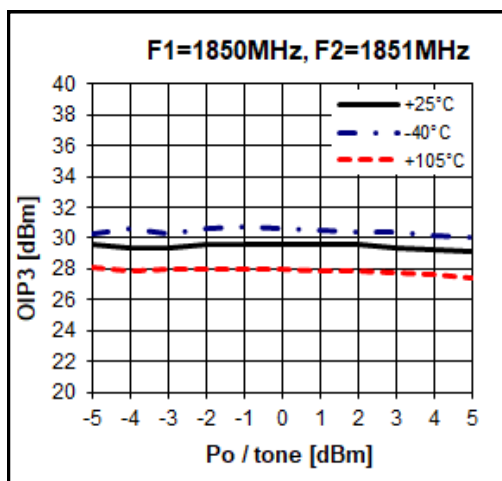
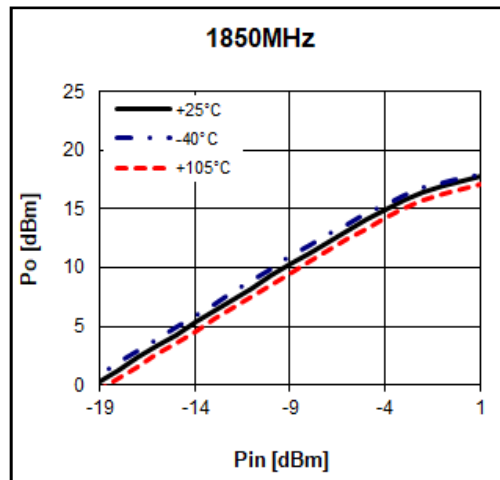
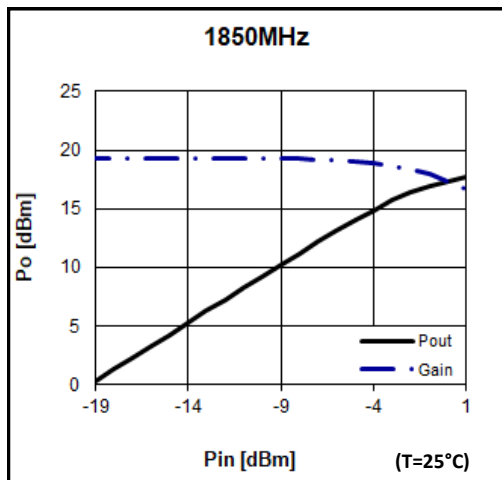
## Typical Performance

$V_d = 3V$ ,  $I_d = 34mA$



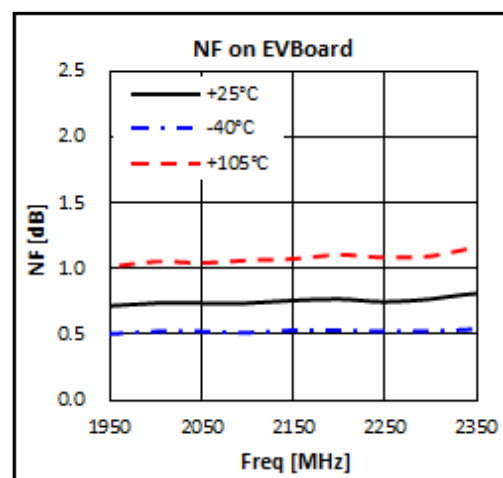
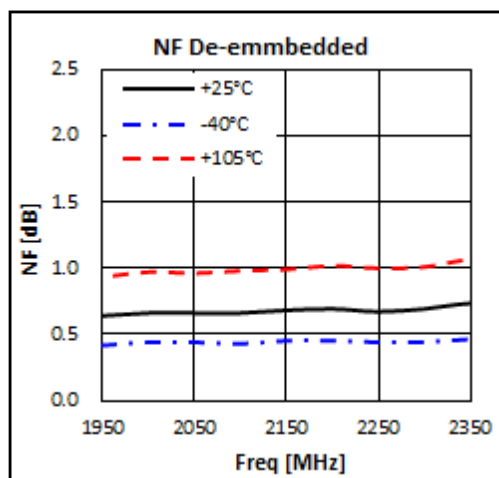
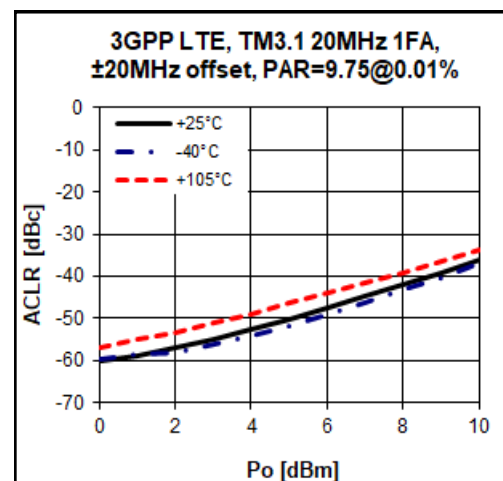
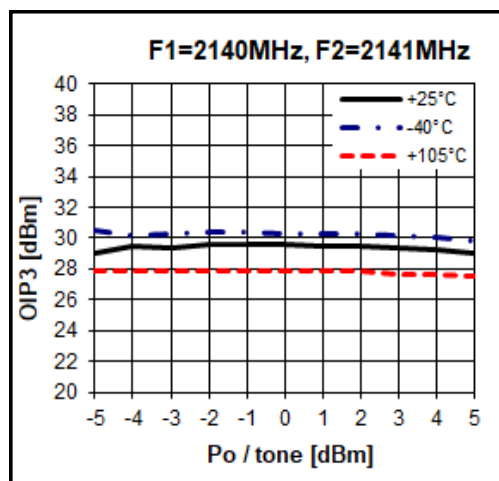
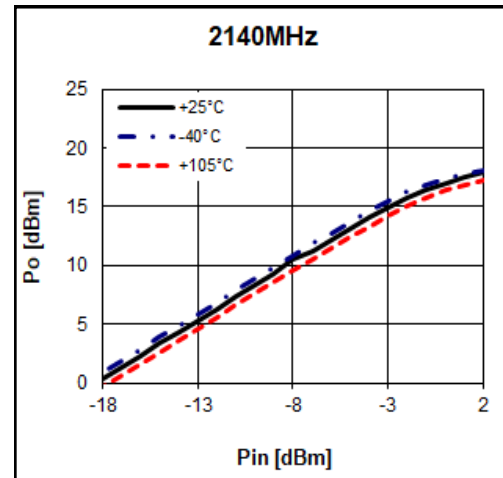
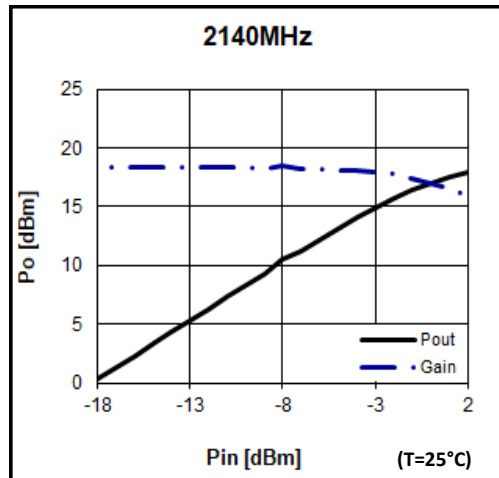
# 1500 – 4000 MHz High Linearity LNA

$V_d = 3V, I_d = 34mA$



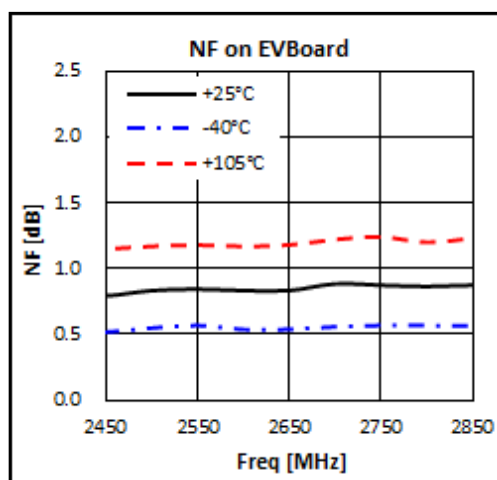
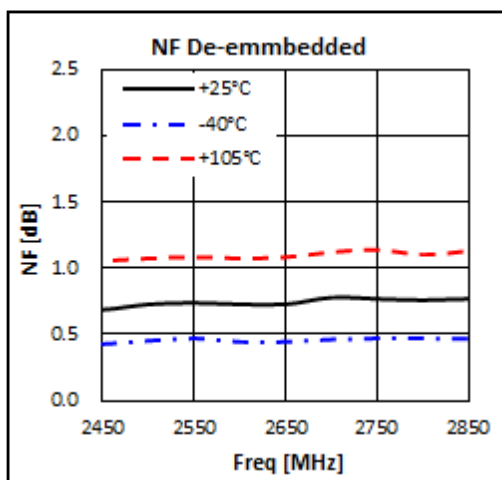
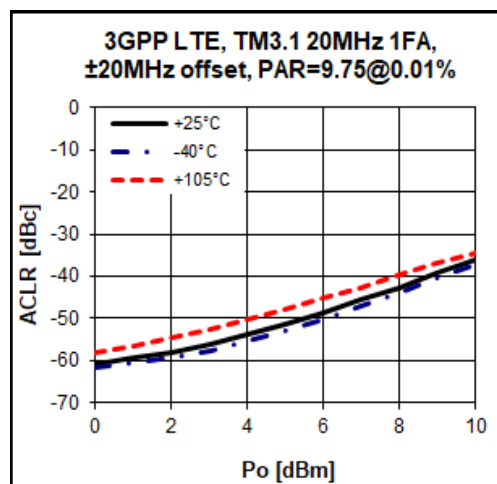
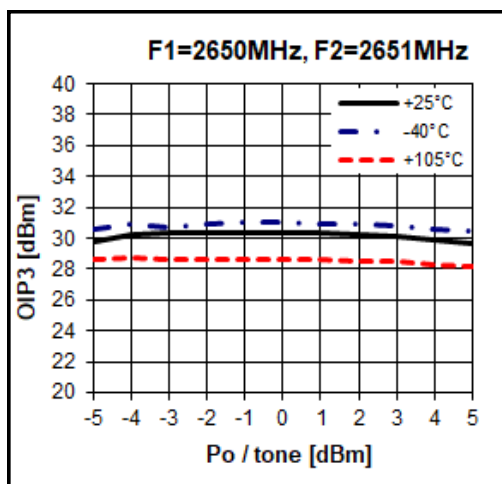
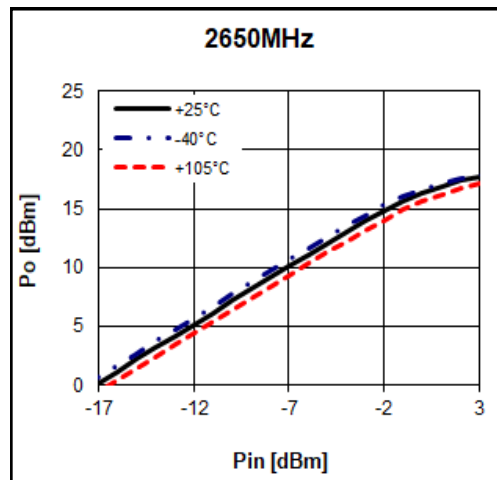
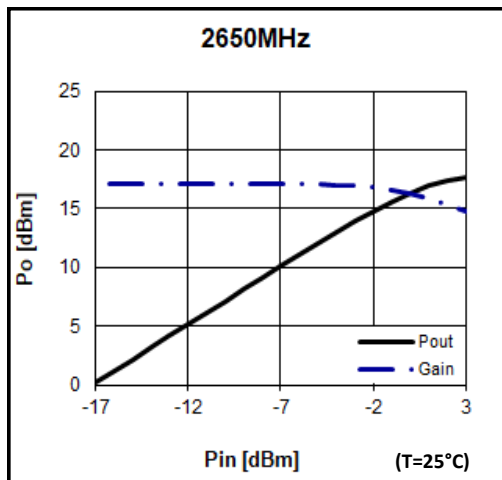
# 1500 – 4000 MHz High Linearity LNA

$V_d = 3V, I_d = 34mA$



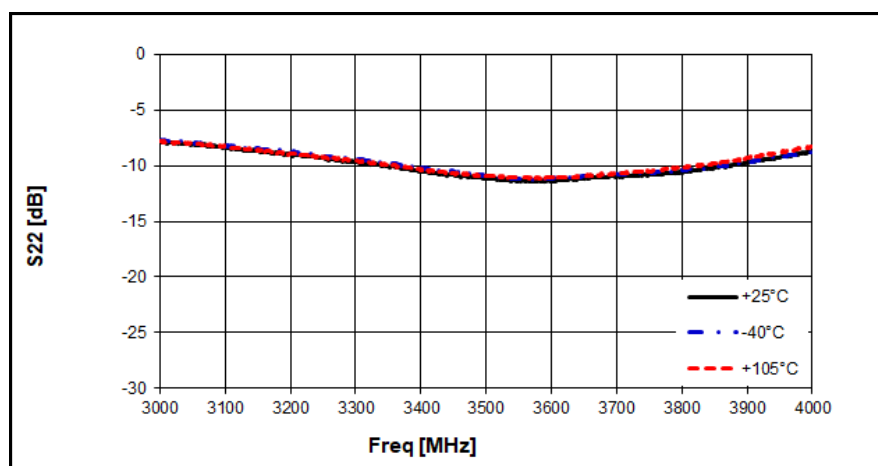
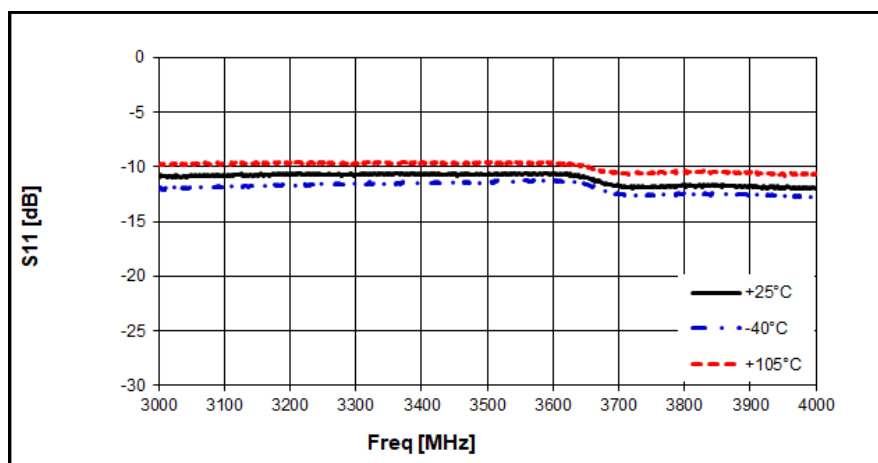
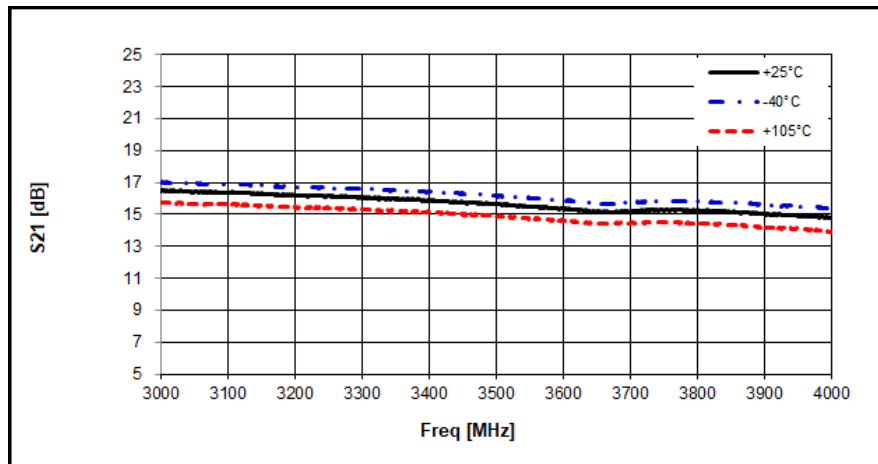
# 1500 – 4000 MHz High Linearity LNA

$V_d = 3V, I_d = 34mA$



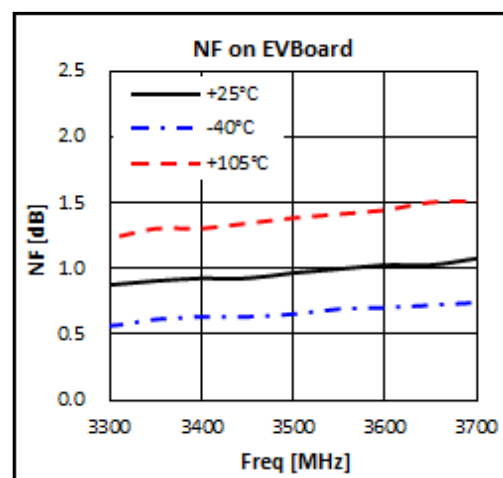
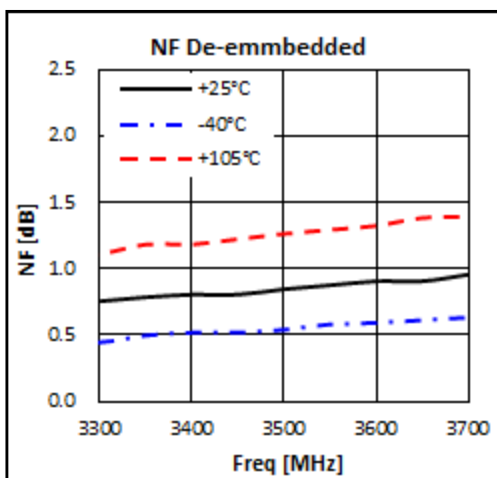
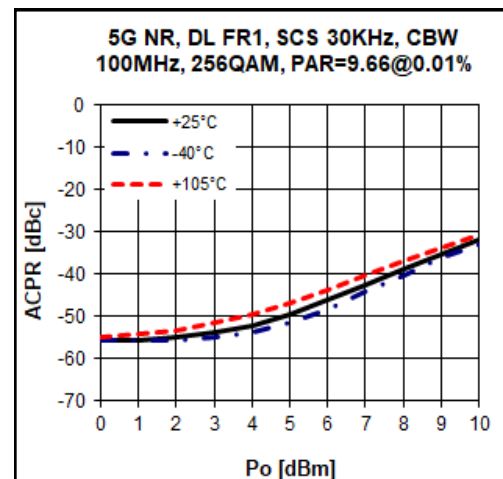
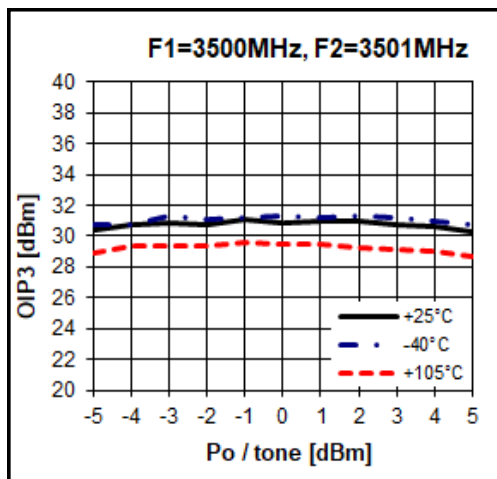
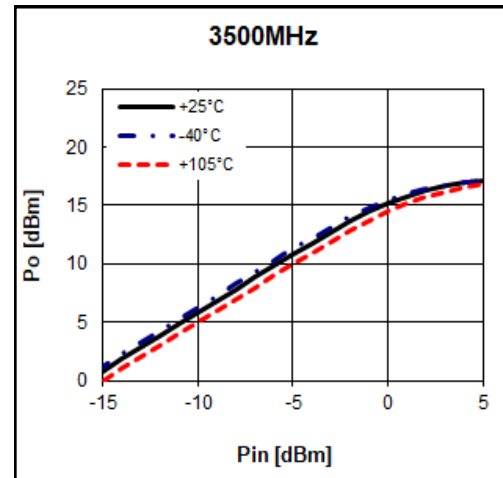
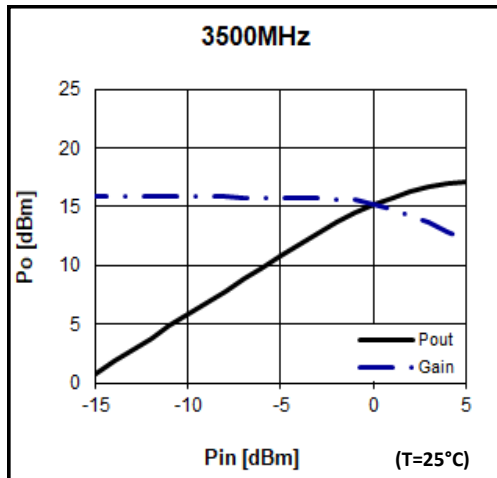
# 1500 – 4000 MHz High Linearity LNA

$V_d = 3V, I_d = 34mA$

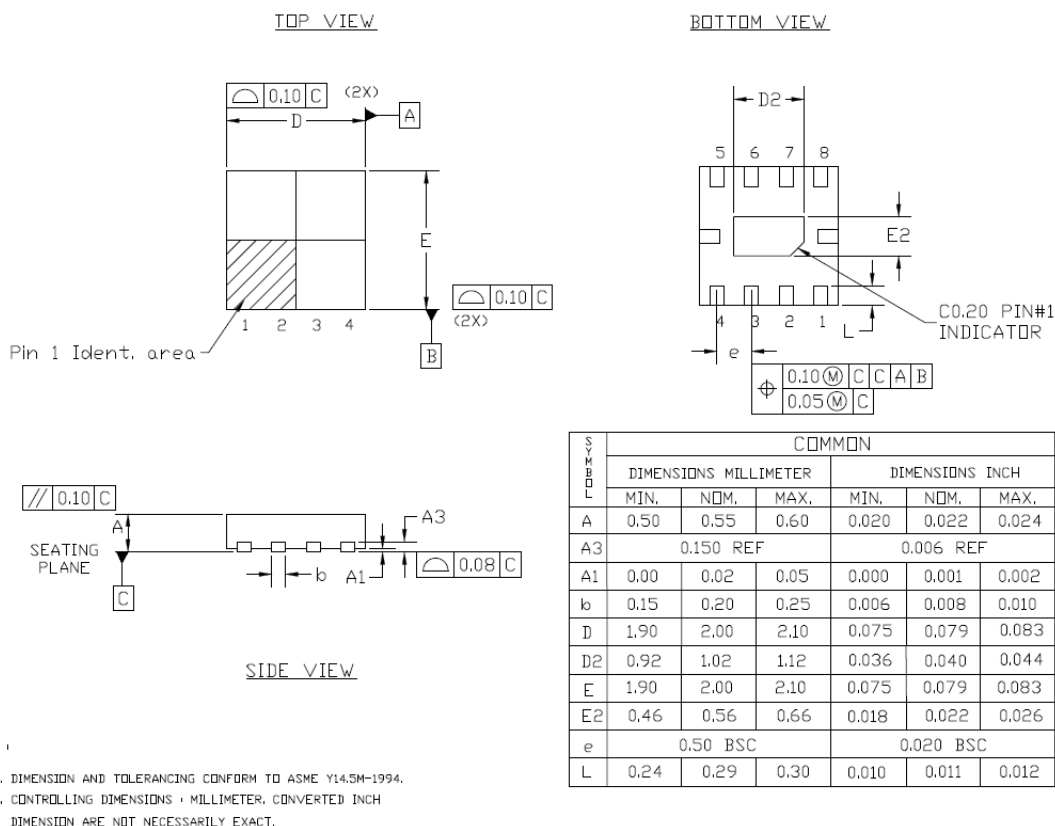


# 1500 – 4000 MHz High Linearity LNA

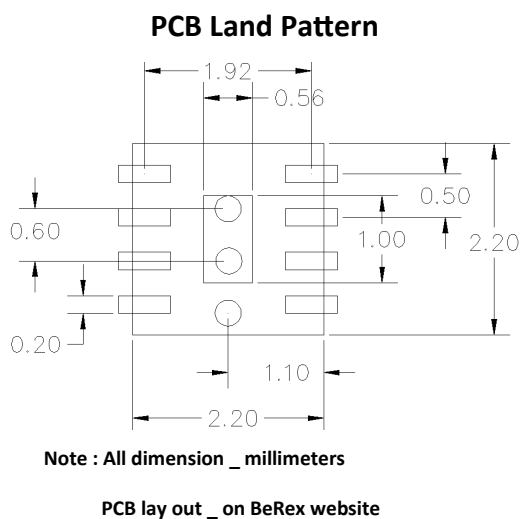
$V_d = 3V, I_d = 34mA$



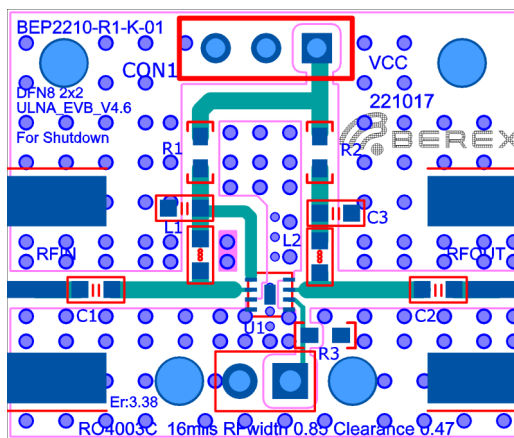
## Package Outline Dimension



## Suggested PCB Land Pattern and PAD Layout

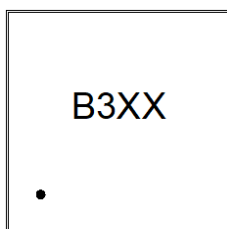


## PCB Mounting



# 1500 – 4000 MHz High Linearity LNA

## Package Marking

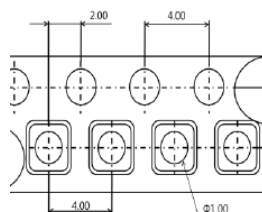


Pin 1

XX = Wafer No.

## Tape & Reel

DFN 8L 2x2



Packaging information:

Tape Width (mm): 8

Reel Size (inches): 7

Device Cavity Pitch (mm): 4

Devices Per Reel: 3000

## Lead plating finish

100% Tin Matte finish

(All BeRex products undergoes a 1 hour, 150 degree C, Anneal bake to eliminate thin whisker growth concerns.)

## MSL / ESD Rating

|                    |                            |
|--------------------|----------------------------|
| <b>ESD Rating:</b> | Class 1C                   |
| <b>Value:</b>      | Passes < 2000 V            |
| <b>Test:</b>       | Human Body Model (HBM)     |
| <b>Standard:</b>   | JEDEC Standard JS-001-2014 |

|                    |                                            |
|--------------------|--------------------------------------------|
| <b>MSL Rating:</b> | <b>Level 1 at +260°C convection reflow</b> |
| <b>Standard:</b>   | JEDEC Standard J-STD-020                   |



Proper ESD procedures should be followed when handling this device.

## 1500 – 4000 MHz High Linearity LNA

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### RoHS Compliance

This part is compliant with Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive 2011/65/EU as amended by Directive 2015/863/EU.

This product also is compliant with a concentration of the Substances of Very High Concern (SVHC) candidate list which are contained in a quantity of less than 0.1%(w/w) in each components of a product and/or its packaging placed on the European Community market by the BeRex and Suppliers.

### NATO CAGE code:

|   |   |   |   |   |
|---|---|---|---|---|
| 2 | N | 9 | 6 | F |
|---|---|---|---|---|

